Creating Functions

Objectives

After completing this lesson, you should be able to do the following:

- Differentiate between a procedure and a function
- Describe the uses of functions
- Create stored functions
- Invoke a function
- Remove a function

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Overview of Stored Functions

A function:

- Is a named PL/SQL block that returns a value

- Can be stored in the database as a schema object for repeated execution

- Is called as part of an expression or is used to provide a parameter value

Creating Functions

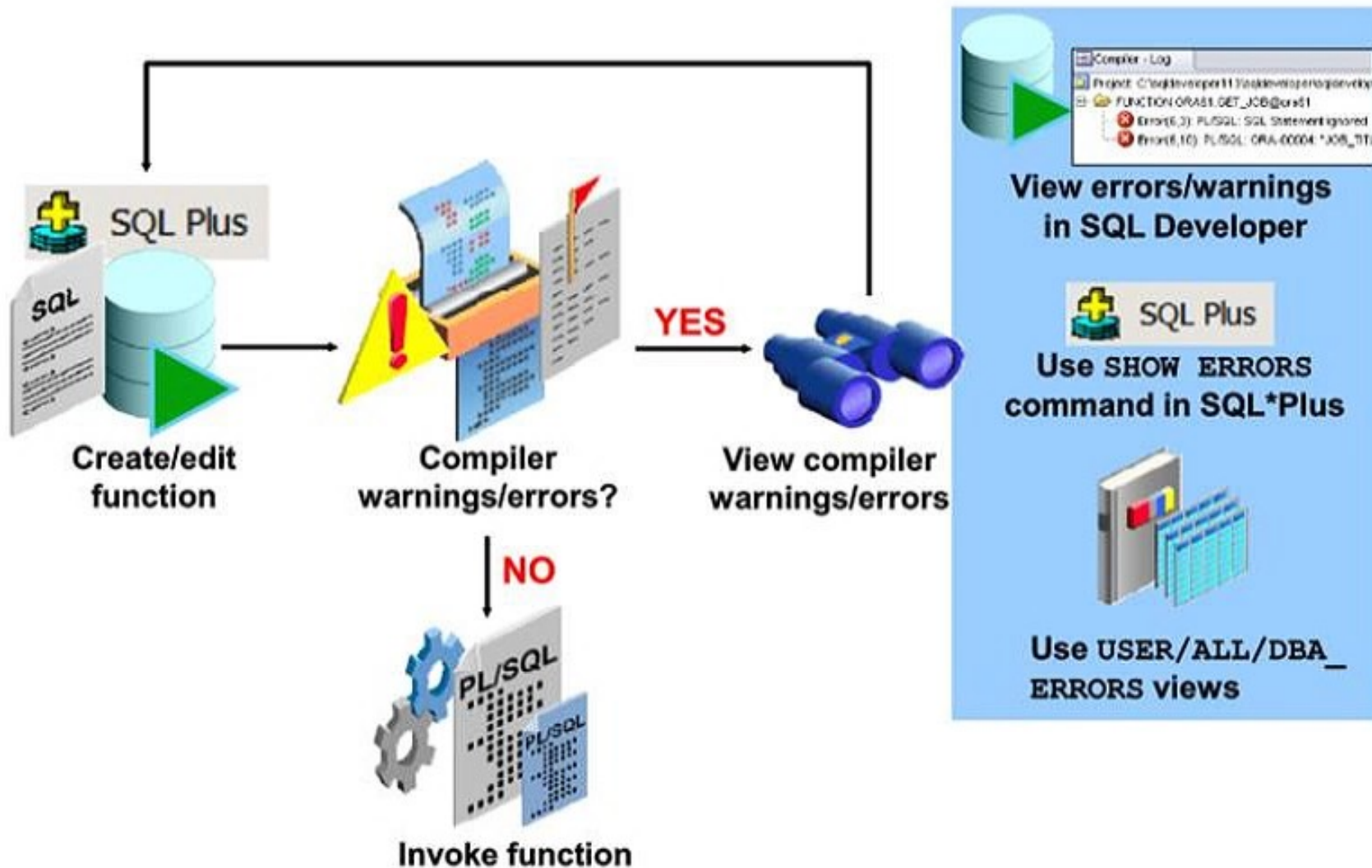The PL/SQL block must have at least one `RETURN` statement.

```
CREATE [OR REPLACE] FUNCTION function_name
  [(parameter1 [mode1] datatype1, . . .)]
RETURN datatype IS|AS
  [local_variable_declarations;
   . . .]
BEGIN
  -- actions;
  RETURN expression;
END [function_name];
```

PL/SQL Block

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The Difference Between Procedures and Functions

Procedures	Functions
Execute as a PL/SQL statement	Invoke as part of an expression
Do not contain RETURN clause in the header	Must contain a RETURN clause in the header
Can pass values (if any) using output parameters	Must return a single value
Can contain a RETURN statement without a value	Must contain at least one RETURN statement

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Creating and Running Functions: Overview

SQL Plus

Create/edit function

Compiler warnings/errors?

YES → View compiler warnings/errors

NO ↓

Invoke function

View errors/warnings in SQL Developer

SQL Plus

Use SHOW ERRORS command in SQL*Plus

Use USER/ALL/DBA_ ERRORS views

Creating and Invoking a Stored Function Using the `CREATE FUNCTION` Statement: Example

```
CREATE OR REPLACE FUNCTION get_sal
 (p_id employees.employee_id%TYPE) RETURN NUMBER IS
  v_sal employees.salary%TYPE := 0;
BEGIN
  SELECT salary
  INTO    v_sal
  FROM    employees
  WHERE   employee_id = p_id;
  RETURN v_sal;
END get_sal; /
```

```
FUNCTION get_sal Compiled.
```

```
-- Invoke the function as an expression or as
-- a parameter value.


EXECUTE dbms_output.put_line(get_sal(100))
```

```
anonymous block completed
24000
```

Using Different Methods for Executing Functions

```
-- As a PL/SQL expression, get the results using host variables

VARIABLE b_salary NUMBER
EXECUTE :b_salary := get_sal(100)
```

```
anonymous block completed
b_salary
-----
24000
```

```
-- As a PL/SQL expression, get the results using a local
-- variable

DECLARE
  sal employees.salary%type;
BEGIN
  sal := get_sal(100);
  DBMS_OUTPUT.PUT_LINE('The salary is: '|| sal);
END;/
```

```
anonymous block completed
The salary is: 24000
```

Using Different Methods for Executing Functions

```
-- Use as a parameter to another subprogram

EXECUTE dbms_output.put_line(get_sal(100))
```

```
anonymous block completed
24000
```

```
-- Use in a SQL statement (subject to restrictions)

SELECT job_id, get_sal(employee_id) FROM employees;
```
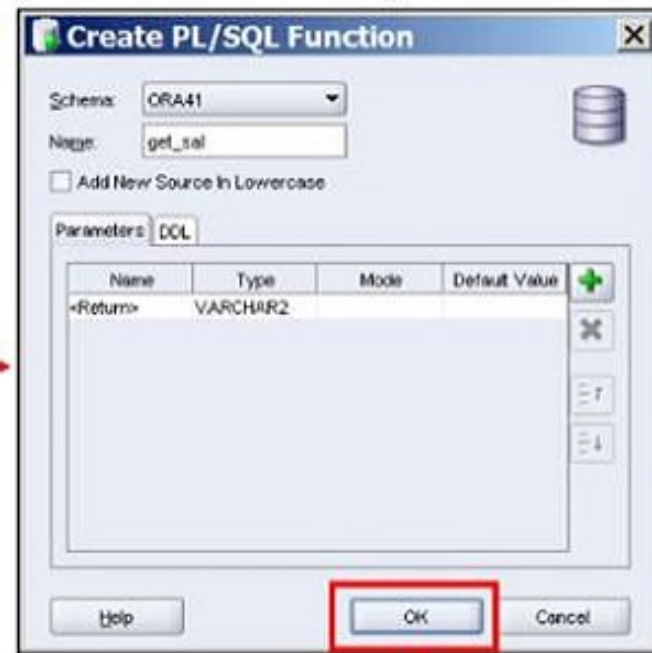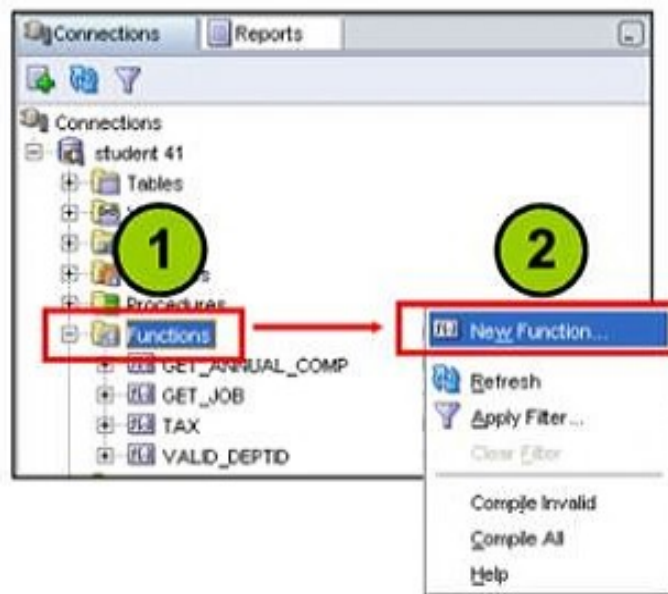
```
JOB_ID      GET_SAL(EMPLOYEE_ID)
----------  --------------------
SH_CLERK    2600
SH_CLERK    2600
AD_ASST     4400
MK_MAN      13000
```
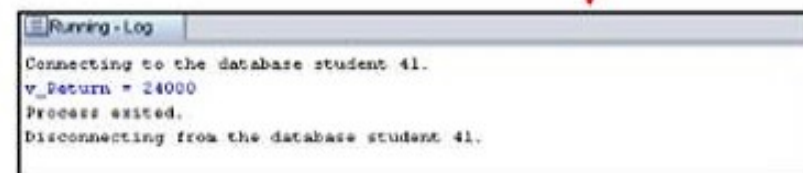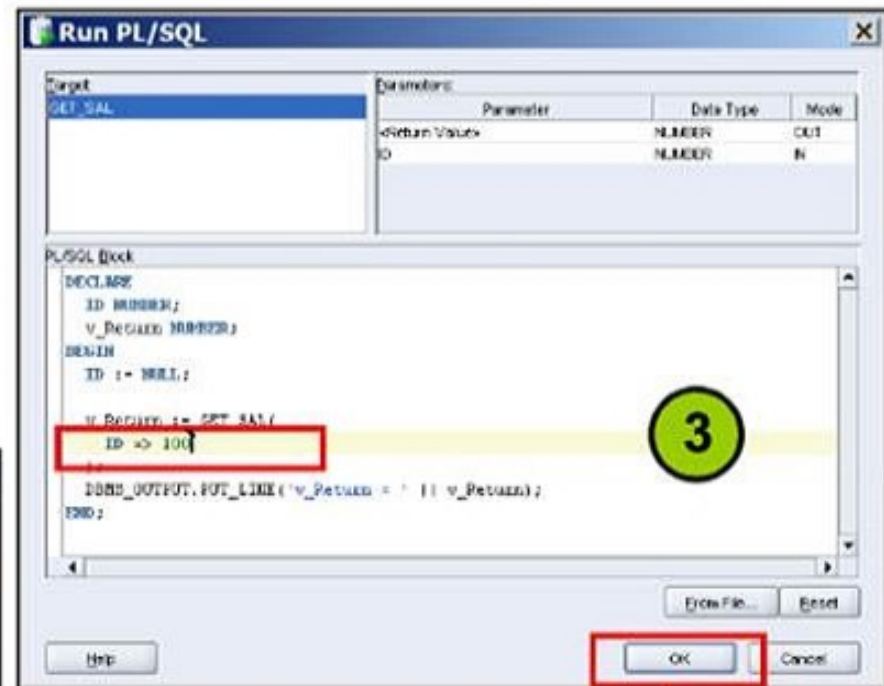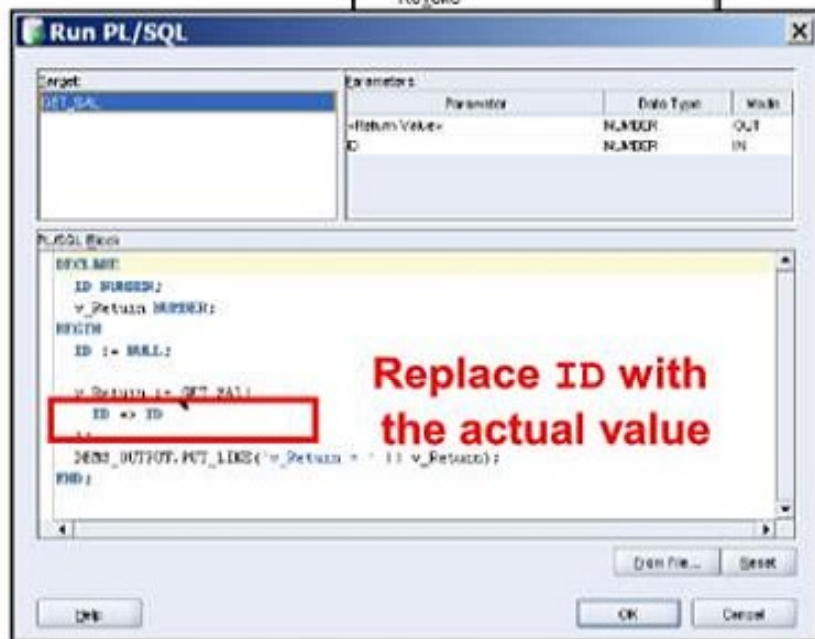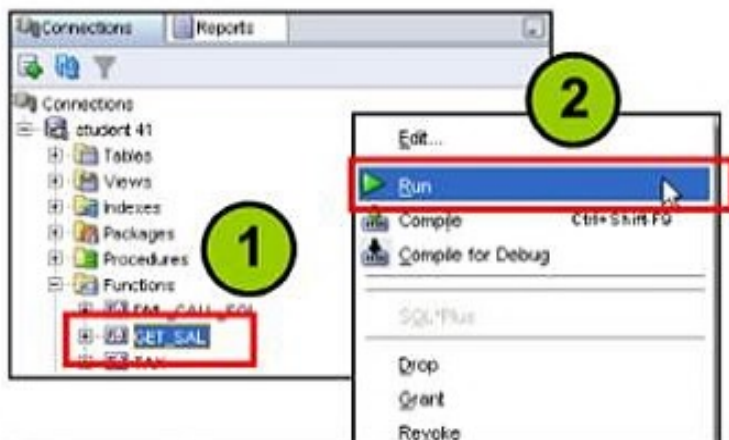
. . .

```
SH_CLERK    3100
SH_CLERK    3000

107 rows selected
```

Creating and Compiling Functions Using SQL Developer

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Executing Functions Using SQL Developer

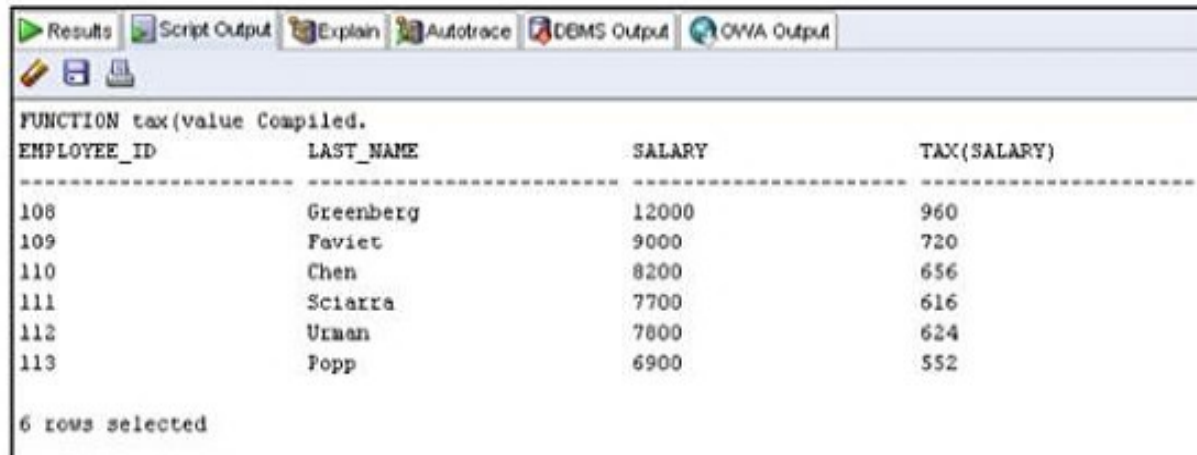Replace ID with the actual value

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Advantages of User-Defined Functions in SQL Statements

- Can extend SQL where activities are too complex, too awkward, or unavailable with SQL
- Can increase efficiency when used in the `WHERE` clause to filter data, as opposed to filtering the data in the application
- Can manipulate data values

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Using a Function in a SQL Expression: Example

```
CREATE OR REPLACE FUNCTION tax(p_value IN NUMBER)
 RETURN NUMBER IS
BEGIN
   RETURN (p_value * 0.08);
END tax;
/
SELECT employee_id, last_name, salary, tax(salary)
FROM    employees
WHERE   department_id = 100;
```

| Results | Script Output | Explain | Autotrace | DBMS Output | OWA Output |

FUNCTION tax(value Compiled.

EMPLOYEE_ID	LAST_NAME	SALARY	TAX(SALARY)
108	Greenberg	12000	960
109	Faviet	9000	720
110	Chen	8200	656
111	Sciarra	7700	616
112	Urman	7800	624
113	Popp	6900	552

6 rows selected

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Calling User-Defined Functions in SQL Statements

User-defined functions act like built-in single-row functions and can be used in:

- The `SELECT` list or clause of a query
- Conditional expressions of the `WHERE` and `HAVING` clauses
- The `CONNECT BY`, `START WITH`, `ORDER BY`, and `GROUP BY` clauses of a query
- The `VALUES` clause of the `INSERT` statement
- The `SET` clause of the `UPDATE` statement

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Restrictions When Calling Functions from SQL Expressions

- User-defined functions that are callable from SQL expressions must:

  - Be stored in the database

  - Accept only `IN` parameters with valid SQL data types, not PL/SQL-specific types

  - Return valid SQL data types, not PL/SQL-specific types

- When calling functions in SQL statements:

  - You must own the function or have the `EXECUTE` privilege

Controlling Side Effects When Calling Functions from SQL Expressions

Functions called from:

- A `SELECT` statement cannot contain DML statements

- An `UPDATE` or `DELETE` statement on a table `T` cannot query or contain DML on the same table `T`

- SQL statements cannot end transactions (that is, cannot execute `COMMIT` or `ROLLBACK` operations)

Note: Calls to subprograms that break these restrictions are also not allowed in the function.

Restrictions on Calling Functions from SQL: Example

```
CREATE OR REPLACE FUNCTION dml_call_sql(p_sal NUMBER)
    RETURN NUMBER IS
BEGIN
   INSERT INTO employees(employee_id, last_name,
                    email, hire_date, job_id, salary)
   VALUES(1, 'Frost', 'jfrost@company.com',
          SYSDATE, 'SA_MAN', p_sal);
   RETURN (p_sal + 100);
END;
```

```
UPDATE employees
   SET salary = dml_call_sql(2000)
WHERE employee_id = 170;
```

```
FUNCTION dml_call_sql(p_sal Compiled.

Error starting at line 1 in command:
UPDATE employees
   SET salary = dml_call_sql(2000)
WHERE employee_id = 170
Error report:
SQL Error: ORA-04091: table ORA62.EMPLOYEES is mutating, trigger/function may not see it
ORA-06512: at "ORA62.DML_CALL_SQL", line 4
04091. 00000 -  "table %s.%s is mutating, trigger/function may not see it"
*Cause:    A trigger (or a user defined plsql function that is referenced in
           this statement) attempted to look at (or modify) a table that was
           in the middle of being modified by the statement which fired it.
*Action:   Rewrite the trigger (or function) so it does not read that table.
```

Named and Mixed Notation from SQL

- PL/SQL allows arguments in a subroutine call to be specified using positional, named, or mixed notation

- Prior to Oracle Database 11*g*, only the positional notation is supported in calls from SQL

- Starting in Oracle Database 11*g*, named and mixed notation can be used for specifying arguments in calls to PL/SQL subroutines from SQL statements

- For long parameter lists, with most having default values, you can omit values from the optional parameters

- You can avoid duplicating the default value of the optional parameter at each call site

Named and Mixed Notation from SQL: Example

```
CREATE OR REPLACE FUNCTION f(
  p_parameter_1 IN NUMBER DEFAULT 1,
  p_parameter_5 IN NUMBER DEFAULT 5)
RETURN NUMBER
IS
 v_var number;
BEGIN
  v_var := p_parameter_1 + (p_parameter_5 * 2);
  RETURN v_var;
END f;
/
```

```
FUNCTION f( Compiled.
```
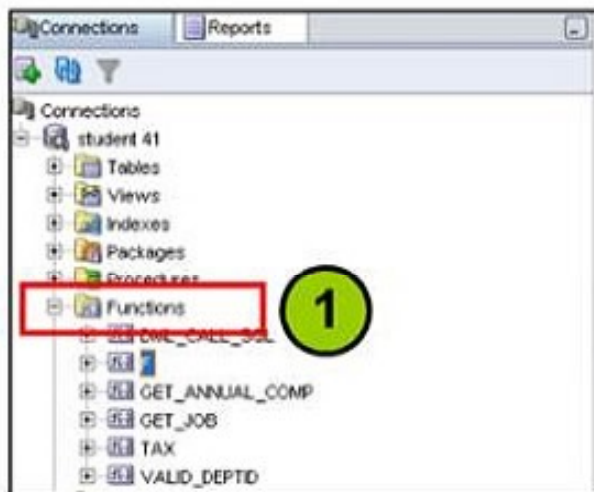
```
SELECT f(p_parameter_5 => 10) FROM DUAL;
```

```
F(P_PARAMETER_5=>10)
----------------------
21

1 rows selected
```

Removing Functions: Using the DROP SQL Statement or SQL Developer

- **Using the DROP statement:**

```
DROP FUNCTION f;
```

- **Using SQL Developer:**

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Viewing Functions
Using Data Dictionary Views

```
DESCRIBE USER_SOURCE
```

```
DESCRIBE user_source
Name                            Null     Type
------------------------------- -------- --------------------
NAME                                     VARCHAR2(30)
TYPE                                     VARCHAR2(12)
LINE                                     NUMBER
TEXT                                     VARCHAR2(4000)

4 rows selected
```
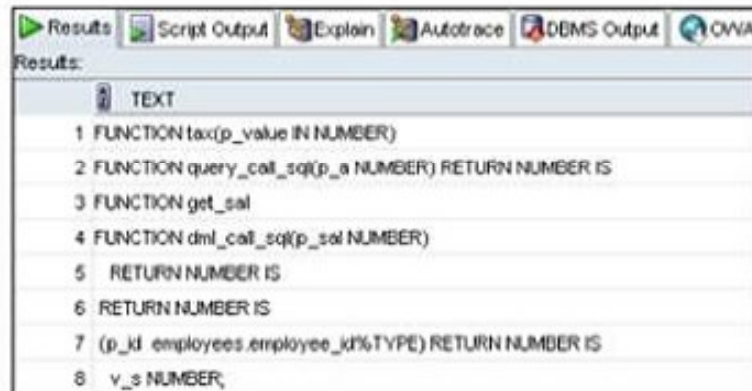
```
SELECT    text
FROM      user_source
WHERE     type = 'FUNCTION'
ORDER     BY line;
```

	TEXT
1	FUNCTION tax(p_value IN NUMBER)
2	FUNCTION query_call_sql(p_a NUMBER) RETURN NUMBER IS
3	FUNCTION get_sal
4	FUNCTION dml_call_sql(p_sal NUMBER)
5	RETURN NUMBER IS
6	RETURN NUMBER IS
7	(p_id employees.employee_id%TYPE) RETURN NUMBER IS
8	v_s NUMBER;

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Quiz

A PL/SQL function:

1. Can be invoked as part of an expression
2. Must contain a `RETURN` clause in the header
3. Must return a single value
4. Must contain at least one `RETURN` statement
5. Does not contain a `RETURN` clause in the header

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Summary

In this lesson, you should have learned how to:

- Differentiate between a procedure and a function
- Describe the uses of functions
- Create stored functions
- Invoke a function
- Remove a function

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Practice 3: Overview

This practice covers the following topics:

- Creating stored functions:
  - To query a database table and return specific values
  - To be used in a SQL statement
  - To insert a new row, with specified parameter values, into a database table
  - Using default parameter values
- Invoking a stored function from a SQL statement
- Invoking a stored function from a stored procedure

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